

CHAPTER 23

WOOD

780 CMR 2301.0 GENERAL

2301.1 Scope: The provisions of 780 CMR 23 shall govern the materials, design, construction and quality of wood.

780 CMR 2302.0 DEFINITIONS

2302.1 General: The following words and terms shall, for the purposes of 780 CMR and as used elsewhere in 780 CMR, have the meanings shown herein.

Native lumber: *Native lumber is wood processed in the Commonwealth of Massachusetts by a mill registered in accordance with 780 CMR. Such wood may be ungraded but is stamped or certified in accordance with the requirements of 780 CMR R-4. Native lumber shall be restricted to use in one- and two-story dwellings, barns, sheds, agricultural and accessory buildings and other structures when permitted by 780 CMR 2303.*

Nominal dimension (lumber): A dimension that varies from actual dimensions in accordance with DOC PS 20 listed in *Appendix A*.

Particleboard: Particleboard is a mat-formed panel consisting of particles of wood or a combination of wood particles and wood fibers bonded together with synthetic resins or other suitable bonding systems (see 780 CMR 2308.0).

Preservative treatment (treated material): Unless otherwise noted, means impregnation under pressure with a wood preservative. A wood preservative is any suitable substance that is toxic to fungi, insects, borers and other living wood-destroying organisms.

780 CMR 2303.0 PERFORMANCE REQUIREMENTS

2303.1 Structural design: All structural wood members and connections shall be of sufficient size or capacity to carry all design *loads* as required by 780 CMR 16 without exceeding the allowable design values specified in AFPA NDS listed in *Appendix A*. Trusses and long-span girders shall be designed with sufficient camber, or other provision shall be made to counteract any deflection other than that permitted in 780 CMR 1606.5. Design values shall be adjusted for wood that is pressure impregnated with fireretardant chemicals. Such adjustment shall be in accordance with 780 CMR 2310.2.1.

2303.1.1 Identification: All lumber utilized for load-supporting purposes, including end-jointed or edge-glued lumber, shall be identified by the grade mark of an approved lumber grading or an *approved inspection agency*. Grading practices and identification shall be in accordance with rules published by an *approved agency*. In lieu of a grade mark on the material, a certificate of inspection as to species and grade which is issued by an approved lumber grading or an *approved inspection agency* shall be accepted for precut, remanufactured or rough-sawn lumber, and for sizes larger than three inches nominal in thickness. Fireretardant-treated wood shall be *labeled* in accordance with 780 CMR 2310.2.2.

2303.2 Native lumber: *Native lumber, as defined in 780 CMR 2302.1 shall be acceptable for use in one and two story dwellings, barns, sheds, agricultural and accessory structures. Native lumber shall also be acceptable for use in other one and two story structures as columns when the design loads are 25% greater than required elsewhere by 780 CMR; as joists, principal beams, and girders in floor constructions when the design loads are 15% greater than required elsewhere by 780 CMR; and as other elements when the design loads are as required elsewhere by 780 CMR.*

Each piece of native lumber produced shall be stamped with the name and registration number of

THE MASSACHUSETTS STATE BUILDING CODE

the producer in accordance with the 780 CMR. In addition, all native lumber shall bear an approved mark identifying the species of wood. In lieu of the stamp bearing the name and registration number and species identification, a certification bearing the same information may be provided by the producer for precut or re-manufactured lumber in accordance with 780 CMR. When native lumber is used, it shall be subject to the following requirements:

1. Sizing criteria: For lumber, sized in accordance with the DOC PS-20-70, figures for maximum fiber stress and modulus of elasticity

for framing grade No. 2 will be used in establishing span and spacing characteristics for all structural members.

2. Stress criteria: Lumber which is sized in excess of the dimensions established by the DOC PS-20-70 for the given nominal size referenced shall be allowed to have a maximum fiber stress increase above that provided in 780 CMR 2303.2 item 1 in proportion to the increased bearing capacity of the cross section as provided in Table 2303.2 or as calculated.

**TABLE 2303.2
NATIVE LUMBER - ALLOWABLE STRESSES**

Nominal Size	Actual Lumber Size Closest size which does not exceed the size shown)	Multiplier factor based on lumber width	Factor to be added to multiplier factor for lumber oversized in thickness	
	Actual Size (thickness x width)		Thickness increase of 1/4" to 1/2"	Thickness increase of over 1/2" to 1"
3 x 8	2 1/2 x 7 1/2	1.0 x Fs	+0.10	+0.20
	2 1/2 x 7 3/4	1.07		
	2 1/2 x 8	1.14		
3 x 10	2 1/2 x 9 1/2	1.0	+0.10	+0.20
	2 1/2 x 9 3/4	1.05		
	2 1/2 x 10	1.11		
3 x 12	2 1/2 x 11 1/2	1.0	+0.10	+0.20
	2 1/2 x 11 3/4	1.04		
	2 1/2 x 12	1.09		
3 x 14	2 1/2 x 13 1/2	1.0	+0.10	+0.20
	2 1/2 x 13 3/4	1.04		
	2 1/2 x 14	1.07		
4 x 10	3 1/2 x 9 1/2	1.0	+0.07	+0.14
	3 1/2 x 9 3/4	1.05		
		1.11		

	$3\frac{1}{2} \times 10$			
4 x 12	$3\frac{1}{2} \times 11\frac{1}{2}$ $3\frac{1}{2} \times 11\frac{3}{4}$ $3\frac{1}{2} \times 12$	1.0 1.04 1.09	+0.07	+0.14
4 x 14	$3\frac{1}{2} \times 13\frac{1}{2}$ $3\frac{1}{2} \times 13\frac{3}{4}$ $3\frac{1}{2} \times 14$	1.0 1.04 1.08	+0.07	+0.14

2303.3 Fireresistance: All wood structural elements shall comply with Table 602.

2303.4 Flameresistance: All wood surfaces used as interior finishes and all exposed surfaces as described in 780 CMR 801.1 shall conform to the requirements of 780 CMR 803.0.

2303.5 Combustibility: Wood used as structural elements or portions thereof shall be limited to combustible structural elements as required by 780 CMR.

Exceptions:

1. Fireretardant-treated wood as permitted by Table 602, Note d, and which complies with 780 CMR 2310.0.
2. As specifically permitted by 780 CMR 602.4.1.

780 CMR 2304.0 HEAVY TIMBER CONSTRUCTION

2304.3 Columns: Wood columns shall be sawn or glued-laminated and shall not be less than eight inches nominal in any dimension where supporting floor *loads*; not less than six inches nominal in width, and not less than eight inches nominal in depth where supporting only roof and ceiling *loads*. Columns shall be continuous or superimposed throughout all stories by means of reinforced

2304.1 Material grade and design: All structural wood members, sawn or glued-laminated, which are installed in buildings and structures of Type 4 construction shall be stress-grade timbers identified as to grade and strength by *approved manufacturing, testing or inspection agencies or bureaus*. All structural timber members shall have the minimum dimensions specified in 780 CMR 2304.3 through 2304.6 for buildings and structures of Type 4 construction and shall be designed, fabricated and installed in accordance with AFPA NDS and AITC 108, 112, 117, 119 and A190.1 listed in **Appendix A**.

2304.2 Steel or concrete: Structural steel or reinforced concrete members shall not be substituted for timber in any part of the structural frame unless *protected* to develop the required fireresistance rating specified in Table 602, but not less than a one-hour fireresistance rating. Structural members that support walls shall be *protected* to afford the same fireresistance rating as the wall supported.

concrete or metal caps with brackets, or shall be connected by properly designed steel or iron caps, with pintles and base plates, or by timber splice plates affixed to the columns by means of metal connectors housed within the contact faces, or by other approved methods. Girders or trusses which support columns shall have at least a one-hour fireresistance rating.

THE MASSACHUSETTS STATE BUILDING CODE

2304.4 Floors: Floors shall be without concealed spaces and shall be constructed of sawn, glued-laminated, splined or tongue-and-groove planks not less than three inches nominal in thickness and covered with a one-inch nominal dimension tongue-and-groove flooring, laid crosswise or diagonally, or 15/32-inch wood structural panel or ½-inch *particleboard*; or of planks not less than four inches nominal in width that are set on edge close together and securely spiked, and covered with one-inch *particleboard*. The lumber shall be laid so that a continuous line of joints will not occur except at points of support and so that planks are not spiked to supporting girders that are parallel to the lamination of the floor. Floors and flooring shall not extend closer than ½-inch (13 mm) to walls so as to provide an expansion joint. Such ½-inch (13 mm) spaces shall be covered by a molding fastened to the wall either above or below the floor and arranged such that the molding will not obstruct the expansion or contraction movements of the floor, or, as an alternative, corbeling of masonry walls under floor shall be utilized in place of molding.

2304.4.1 Floor joists, beams and girders: Joists, beams and girders of wood shall be constructed of sawn or glued-laminated timber and shall not be less than six inches nominal in width, and not less than ten inches nominal in depth. Framed sawn or glued-laminated timber arches that spring from the floor line and support floor *loads* shall not be less than eight inches nominal in any dimension. Framed timber trusses supporting floor *loads* shall have members of not less than eight inches nominal in any dimension.

2304.5 Roofs: Roofs shall be without concealed spaces and roof decks shall be constructed of: sawn, glued-laminated, splined or tongue-and-groove planks not less than two inches nominal in thickness; 1½-inch-thick interior wood structural panel (exterior glue); or of planks not less than three inches nominal in width that are set on edge close together and laid as required for floors in 780 CMR 2304.4.

2304.5.1 Arches: Framed or glued-laminated arches for roof construction which spring from the floor line or from grade and do not support floor *loads* shall have members not less than six inches nominal in width, not less than eight inches nominal in depth for the lower half of the height and not less than six inches nominal in depth for the upper half. Framed or glued-laminated arches for roof construction which spring from the top of walls or wall abutments, framed timber trusses and other roof framing which does not support floor *loads* shall have members not less than four inches nominal in width and not less than six inches nominal in depth. Spaced members shall be composed of two or more pieces not less than three inches nominal in thickness where blocked solidly throughout their intervening spaces or where such spaces are tightly closed by a continuous wood cover plate of not less than two inches nominal in thickness, secured to the underside of the members. Splice plates shall not be less than three inches nominal in thickness. Where equipped with an *automatic sprinkler system* installed in accordance with 780 CMR 906.2.1, 906.2.2 or 907.0 under the roof deck, framing members shall not be less than three inches nominal in width.

2304.6 Interior wall construction: Walls shall be of solid wood construction formed by not less than two layers of one-inch matched boards, laminated construction four inches in thickness, or of one-hour fire-resistance rated construction.

2304.7 Exterior structural members: Wood columns and arches conforming to heavy timber sizes shall only be installed externally where a *fire separation distance* of 20 feet (6096 mm) or more is provided. Where a *fire separation distance* of less than 20 feet (6096 mm) is provided, columns and arches shall be permitted where located inside an exterior wall, and the exterior wall has a fire-resistance rating not less than required by Table 602, for exterior walls.

2304.8 Beams and girders: Beams and girder supports and connections shall comply with 780 CMR 2305.6.3 and 2305.6.4.

2304.9 Column connections: Girders and beams shall be closely fitted around columns and adjoining ends shall be cross tied to each other, or inter-tied by caps or ties, to transfer horizontal *loads* across the joint. Wood bolsters shall not be placed on tops of columns unless the columns support roof *loads* only.

2304.10 Maintenance: All connections in the joints of timber trusses and structural frames shall be

2305.1 Design and construction: Exterior walls, interior partitions, floors and roofs of wood construction shall be designed and constructed in accordance with 780 CMR 2305.0, 780 CMR 2303.0 and 780 CMR 2307.0 through 2312.0.

2305.2 Fastening: The quantity and size of fasteners connecting wood frame members together and sheathing materials to wood frame members shall not be less than that specified in Table 2305.2.

2305.3 Cutting and notching: It shall be unlawful to notch, cut or pierce wood beams, joists, rafters or studs in excess of the limitations herein specified, unless proven safe by structural analysis or suitably reinforced to transmit all calculated *loads*.

2305.3.1 Notches: Notches in joists, rafters and beams shall not exceed 1/6 of the depth of the member, shall not be longer than 1/3 of the depth of

inspected periodically. Bolts and other connectors shall be maintained tight.

2304.11 Framing around flues and chimneys: Clearances for combustible framing members from all flues, chimneys and fireplaces shall be in accordance with 780 CMR 2305.12.

780 CMR 2305.0 WOOD FRAME CONSTRUCTION

the member and shall not be located in the middle 1/3 of the span. Notch depth at the ends of the member shall not exceed 1/4 of the depth of the member.

Exceptions:

1. A notch over the support is permitted to extend the full width of the support.
2. Notches on cantilevered portions of the member are permitted to extend the full length of the cantilever if the strength and deflection of the cantilever is calculated based on the reduced member section.
3. The tension side of beams, joists and rafters which are four inches or greater in nominal thickness, shall not be notched, except at ends of members.

**Table 2305.2
FASTENING SCHEDULE**

Building element	Nail or staple size and type	Number and location
1. Floor construction		
Built up to girders and beams	20d common	32" o.c. direct
Bridging to joists	8d common	2 each direct end
Floor joists to studs (no ceiling joists)	10d common	5 direct or
	10d common	3 direct
Floor joists to studs (with ceiling joists)	10d common	2 direct
Floor joists to sill or girder	8d common	3 toe nail

780 CMR: STATE BOARD OF BUILDING REGULATIONS AND STANDARDS

THE MASSACHUSETTS STATE BUILDING CODE

Building element	Nail or staple size and type	Number and location
Ledger strip	16d common	3 each direct joist
1" subflooring (6" or less)	8d common	2 each direct joist
1" subflooring (8" or more)	8d common	3 each direct joist
2" subflooring	16d common	2 each direct joist
Particleboard underlayment ($\frac{1}{4}$ " - $\frac{3}{4}$ ")	6d annular threaded	6" o.c. direct edges and 12" o.c. intermediate
Particleboard subflooring (? or greater)	8d common	6" o.c. direct edges and 12" o.c. intermediate
Wood structural panel subflooring ($\frac{1}{2}$ " or less)	6d common <i>or</i> 6d annular or spiral thread	6" o.c. direct edges and 12" o.c. intermediate
($\frac{19}{32}$ " - $\frac{3}{4}$ ")	8d common <i>or</i> 6d annular or spiral thread	6" o.c. direct edges and 12" o.c. intermediate
(? $\frac{1}{2}$ " - 1?)	10d common <i>or</i> 8d ring shank <i>or</i> 8d annular or spiral thread	6" o.c. direct edges and 6" o.c. intermediate
($\frac{1}{2}$ " or less)	16 gage galvanized wire staples	4" o.c. edges and 7" o.c. intermediate
2. ($\frac{19}{32}$ ", ?")	? minimum crown, 1? length	2 $\frac{1}{2}$ " o.c. edges and 4" o.c. intermediate
Wall construction		
Stud to sole plate	8d common	4 toe nail or
	16d common	2 direct nail
Stud to cap plate	16d common	2 toe nail or 2 direct nail
Double studs	10d common	12" o.c. direct
Corner studs	16d common	24" o.c. direct
Sole plate to joist or blocking	16d common	16" o.c.
Interior-braced wall sole plate to parallel joist	16d common	12" o.c.
Double cap plate	10d common	16" o.c. direct nail
Cap plate laps	10d common	2 direct nail
Ribbon strip 6" or less	10d common	2 each direct bearing
Ribbon strip 6" or more	10d common	3 each direct bearing
Diagonal brace (to stud and plate)	8d common	2 each direct bearing
Interior -braced wall top plate to joist or blocking	10d common	12" o.c.
Tail beams to headers (where nailing is permitted)	20d common	1 each end 4 sq. ft. floor area
Header beams to trimmers (where nailing is permitted)	20d common	1 each end 8 sq. ft. floor area
Continuous header to stud	8d common	4 toe nail
3. Continuous header, two pieces	16d common	16" o.c. direct
Roof and ceiling construction		
Ceiling joists to plate	16d common	3 toe nail
Ceiling joists (laps over partition)	10d common	3 direct nail
Ceiling joists (parallel to rafter)	10d common	3 direct nail
Collar beam	10d common	3 direct
Roof rafter to plate	8d common	3 toe nail
Roof rafter to ridge	16d common	2 toe nail or direct nail

Building element	Nail or staple size and type	Number and location
Jack rafter to hip	10d common	3 toe nail or
	16d common	2 direct nail
1" roof decking (6" or less in width)	8d common	2 each direct rafter
4. 1" roof decking (over 6" in width)	8d common	3 each direct rafter
Wall and roof sheathing		
1" wall sheathing (8" or less in width)	8d common	2 each direct stud
1" wall sheathing (over 8" in width)	8d common	3 each direct stud
Diagonal wall sheathing (seismic bracing)	See Table 2306.4.5	
1/2" fiberboard sheathing	1 1/2" galvanized roofing nail or 6d common nail <i>or</i> 16 gage staple, 1 7/8" long with minimum crown of 7/16"	3" o.c. exterior edge, 6" o.c. intermediate
25/32" fiberboard sheathing	1 3/4" galvanized roofing nail <i>or</i> 8d common nail <i>or</i> 16 gage staple, 1 1/2" long with minimum crown of 7/16"	3" o.c. exterior edge, 6" o.c. intermediate
Gypsum sheathing	12 gage 1 1/4" large head, corrosion resistant	4" o.c. on edge, 8" o.c. intermediate
Gypsum sheathing (seismic bracing)	11 gage 1 3/4" long 7/16" head, diamond point, galvanized	4" o.c. all bearing points
Particleboard roof and wall sheathing (1/2" or less)	6d common	6" o.c. direct edges and 12" o.c. intermediate
(3/4" or greater)	8d common	6" o.c. direct edges and 12" o.c. intermediate
Wood structural panel roof and wall sheathing (1/2" or less)	6d common	6" o.c. direct edges and 12" o.c. intermediate
(19/32" or greater)	8d common	6" o.c. direct edges and 12" o.c. intermediate
(1/2" or less)	16 gage galvanized wire staples, 3/4" minimum crown; length of 1" plus panel thickness	4" o.c. edges and 8" o.c. intermediate
(19/32", 3/4")	Same as immediately above	2 1/2" o.c. edges and 5" o.c. intermediate
Shingles, wood ^a	No. 14 B&S Gage corrosion resistant	2 each bearing
Weatherboarding	8d corrosion resistant	2 each bearing

Note a. Single nails shall penetrate not less than 3/4 inch into nailing strips, sheathing or supporting construction except as otherwise provided for in 780 CMR 1507.0

2305.3.2 Holes: Holes bored or cut into joists, rafters or beams shall not be closer than two inches (51 mm) to the top or bottom of the joist, or to any other hole located in the member. Where the member is notched, the hole shall not be closer than two inches (51 mm) to the notch.

The diameter of the hole in joists shall not exceed 1/4 of the depth of the member.

2305.3.3 Studs: In studs of loadbearing walls or partitions, notches or bored holes shall not be cut or bored more than 1/4 of the depth of the stud

THE MASSACHUSETTS STATE BUILDING CODE

unless reinforced in accordance with 780 CMR

2305.3.4 Reinforcement: Where the stud is cut or bored in excess of $\frac{1}{4}$ of its depth, the stud shall be reinforced to be equal in loadbearing capacity to a stud that is notched not more than $\frac{1}{4}$ of its depth.

2305.4 Loadbearing walls: Posts and studs in loadbearing walls and partitions shall be designed as columns, with due allowance for lateral support furnished by sheathing, intermediate bracing, horizontal bridging, wall coverings and the floor and roof assemblies. The walls shall be fabricated in such a manner as to provide adequate support for the materials that enclose the building and to provide for transfer of all lateral *loads* to the foundation in accordance with 780 CMR 1710.4.

2305.4.1 Wall framing: Studs shall be placed with the wide dimension perpendicular to the wall. Not less than three studs shall be installed at each corner of an exterior wall.

Exception: At corners, a third stud is not required where wood spacers or backup cleats of $\frac{1}{2}$ -inch-thick wood structural panel, $\frac{1}{2}$ -inch Type 2-M *particleboard*, one-inch-thick lumber or other approved devices which serve as an adequate backing for the attachment of facing materials are used. Where fireresistance ratings or shear *loads* apply, wood spacers, backup cleats or other devices shall not be installed unless specifically approved.

2305.4.2 Double top plates: Stud walls shall be capped with double top plates installed to provide overlapping corners and wall intersections. Top plate joints shall be offset not less than 48 inches (1219 mm).

Exception: *Detached one- and two-family dwellings and agricultural storage buildings that are intended only for incidental human occupancy are permitted to have a single top*

2305.3.4.

plate provided that the plate is adequately tied at joints, corners and intersecting walls by at least the equivalent of galvanized steel that is three inches (76 mm) by six inches (152 mm) by 0.036 inches thick and nailed to each wall or segment of wall by three 8d nails or the equivalent, and the rafters, joists or trusses are centered over the studs with a tolerance of not more than one inch (25 mm).

2305.4.3 Bottom plates: Studs shall have full support by a plate or sill. The sill shall have not less than a two-inch nominal thickness and a width at least equal to the width of the studs.

2305.5 Nonloadbearing walls: Studs in nonloadbearing walls and partitions shall not be spaced more than 48 inches (1219 mm) o.c., and are permitted to be erected with the long dimension parallel to the wall, unless otherwise approved as an integrated assembly by testing. A single top plate shall be prohibited except where such plate is installed in accordance with 780 CMR 2305.4.2.

2305.6 Support and anchorage: Support and anchorage of members on girders, walls and beams shall conform to 780 CMR 2305.6.1 through 2305.6.4.

2305.6.1 Support and anchorage on girders: All members framing into girders shall be anchored or tied to secure continuity. The ends of all wood beams that rest on girders shall bear not less than four inches (102 mm) or shall be supported in approved metal stirrups, hangers or on wood clips or ribbon strips. Beams framing from opposite sides shall either lap at least six inches (152 mm) and be bolted or spiked together or, where framed end-to-end, the beams shall be secured together by approved ties, straps, dogs, plates or sheathing.

2305.6.2 Support and anchorage on walls or beams: Except where supported on a 1 x 4 ribbon strip and nailed to the adjoining stud, joists shall

bear on walls or beams of wood or steel not less than 1½ inches (38 mm) or shall be supported by metal stirrups, hangers or a nominal 2-inch wood ledger strip. The minimum bearing on concrete or masonry shall be three inches (76 mm). Joists framing over beams from opposite sides shall either lap at least three inches (76 mm) and be securely fastened together or, where framed end-to-end, the joists shall be secured together by approved ties, straps, dogs, plates or sheathing.

2305.6.3 Girder supports: Wall plate boxes of the self-releasing type, or approved hangers, shall be provided where beams and girders are supported by masonry. An air space of ½ inch (13 mm) shall be provided at the top, end and sides of

2305.7 Wind bracing: In buildings more than one story in *height* and where necessary for strength in one-story buildings, the corner posts shall be the equivalent of not less than two pieces of two-inch by four-inch studs, braced by not less than one piece of one-inch by four-inch continuous-diagonal brace let into the studs. Bracing is not required where diagonal wood sheathing, wood structural panels or *particleboard* panels are installed, or where other sheathing as specified in 780 CMR 2305.13 is applied vertically in panels of not less than four feet by eight feet with approved fasteners complying with Table 2305.2. Other sheathing materials shall be permitted when tested in accordance with ASTM E72 listed in *Appendix A*.

The lateral *load* resistance shall be established by the lesser of: the values determined by dividing the maximum *load* reported in the test by 2.5; or the *load* at which the deflection reported in the test exceeds $h/480$, where h is the height of the test assembly.

2305.8 Seismic bracing: Where structural analysis of the seismic force-resisting system is not provided, buildings shall meet the provisions of 780 CMR 2305.0 and shall have roof and exterior wall *dead loads* less than or equal to 15 psf (73 kg/m²) and floor *dead loads* less than or equal to 10 psf (49 kg/m²).

the member unless approved naturally durable or *preservative-treated* wood in accordance with 780 CMR 2311.0 is installed. Wood beams and girders supported by walls required to have a fire-resistance rating of two hours or more shall have not less than four inches (102 mm) of solid masonry between their ends and the outside face of the wall and between adjacent beams.

2305.6.4 Fire cuts: All wood and other combustible floor, roof and other structural members framing into masonry walls shall be cut to a bevel of three inches (76 mm) in depth and shall project not more than four inches (102 mm) into the wall.

Table 2305.8
WALL SPACING AND HEIGHT
LIMITATIONS FOR WOOD AND FRAME
CONSTRUCTION

Seismic Performance Category	Maximum distance between interior bracing walls (feet)	Maximum Stories (height) permitted
C	25	2 (30 feet)
D ^a	25	1 (20 feet)

Note a: Applies only to Seismic Hazard Exposure Group I; engineering analysis required for Seismic Hazard Exposure Group II

2305.8.1 Wall bracing required: All exterior walls and required interior bracing walls shall be braced by one of the types of sheathing prescribed in table 2305.8.1 for each 25 lineal feet (or 7.6 m) of exterior wall or required interior bracing wall length. The required length of sheathing shall be distributed along the length of the bracing wall with a minimum four foot panel of sheathing at, or within four feet of, each end. Construction of bracing walls shall comply with the requirements of 780 CMR 2305.9

Table 2305.8.1
MINIMUM SEISMIC WALL BRACING PER
25 LINEAL FEET OF INTERIOR AND

THE MASSACHUSETTS STATE BUILDING CODE

EXTERIOR WALL LENGTH^{a,c}

Story location	Sheathing ^b	$A_v = 0.12$
Top or only story	GP	7'-0"
	W/SP	4'-0"
First of two stories or second of three stories	GP	13'-0"
	W/SP	7'-0"
First of three stories	GP	Note c.
	W/SP	

Note a. Interpolation of the tabular values is permitted where the length of wall between exterior walls or interior-braced walls is less than 25 feet.

Note b. GP = Gypsum or *particleboard* sheathing; W/SP = Diagonal wood boards or wood structural panels.

Note c. Analysis of the seismic force-resisting system required.

Note d. One foot = 304.8 mm.

2305.8.2 Double-sheathed walls: Where braced walls are sheathed on both sides with identical sheathing, the required length of sheathing in Table 2305.8.1 is permitted to be taken as $\frac{1}{2}$ the tabular length. Where different sheathing materials are used on either side of a wall, the required length of sheathing in Table 2305.8.1 is permitted to be taken as $\frac{1}{2}$ of the tabular length for the material requiring the greater length. Double-sheathed walls shall have a minimum length of four feet (1219 mm).

2305.8.3 Stud walls: Stud walls that are less than the full height of the story shall be braced as required for exterior walls or interior-braced walls and shall be considered an additional story.

2305.9.2 Parallel floor joist and braced wall connections: Where the floor framing is parallel to the braced wall line, joists shall be doubled

2305.8.4 Sheathing installation: Sheathing shall be installed in accordance with the provisions of Table 2305.13 where acting as wall bracing. To be considered effective as bracing, the sheathing shall be at least 48 inches in width covering three 16-inch stud spaces or two 24-inch stud spaces and be fastened to the wall studs in accordance with Table 2305.2. Sheathing shall be fastened to the wall studs, sole plate and top plate in accordance with Table 2305.2. All vertical joints of panel sheathing shall occur over studs and all horizontal joints shall occur over blocking at least equal in size to the studs. All framing in connection with sheathing used for bracing shall not be less than two inches nominal in thickness.

2305.9 Braced wall: All exterior walls and interior-braced walls required by Table 2305.8, shall be constructed to transfer forces from roofs and floors to braced walls and from the braced walls in upper stories to the braced walls in the story below. Braced wall lines from the story above to the story below are permitted to be offset a maximum of 24 inches (610 mm). Blocking, where required by 780 CMR 2305.9, need only be provided for the length of the wall specified in Table 2305.8.1.

2305.9.1 Roof to braced wall connections: Roof to interior-braced wall connections for buildings with maximum dimensions not over 50 feet (15240 mm) are permitted to be made at the intersection of exterior walls. Double top plates shall be lapped at the intersection and nailed in accordance with Table 2305.2. For buildings with maximum dimensions greater than 50 feet (15240 mm), the interior-braced walls shall be fastened directly to the ceiling joist in accordance with 780 CMR 2305.9.2 or 2305.9.3.

directly beneath the braced wall line and nailed in accordance with Table 2305.2.

Where the upper and lower braced walls are offset, the joist spaces between the offset braced walls shall be blocked with a minimum blocking

size of two inches by six inches, spaced at 32 inches (813 mm) on center, within the joist cavity under the braced wall, and positioned in the upper portion of the cavity. The upper braced wall is permitted to be nailed to the blocking with two 16d nails at each piece of blocking. The lower braced wall shall be toe nailed, in accordance with Table 2305.2, to a joist located directly above the top plates.

2305.9.3 Perpendicular floor joist and braced wall connections: Where the floor framing is perpendicular to the braced wall line, solid blocking for the full depth of the floor joist shall be provided for the length of bracing required. The interior-braced wall shall be nailed to the blocking in accordance with Table 2305.2.

Where the upper and lower braced walls are offset, a minimum of two-inch by six-inch blocking shall be located in the upper portion of the joist space, directly beneath the upper braced wall and in the lower portion of the joist space, directly above the lower braced wall.

2305.10 Multiple stories: Where the frame is more than one story in *height* and studs and posts are not continuous from sill to roof, the members shall be secured together with approved clips, splices or other connections to insure a continuous, well-integrated structure. Sheet metal clamps, ties or clips shall be formed of galvanized steel or other approved corrosion-resistant material equivalent to 0.040-inch nominal thickness steel sheets for two-inch framing members and not less than 0.052-inch nominal thickness steel sheets for three-inch structural members. For four-inch and larger members, column splices and beam and girder supports shall comply with 780 CMR 2304.1.

2305.11 Framing over openings: Headers, double joists, trusses or other approved assemblies which are of adequate size to transfer all superimposed *loads* to the vertical members shall be provided over all window and door openings in loadbearing walls and partitions.

2305.12 Framing around flues and chimneys: Combustible framing shall be a minimum of two inches (51 mm), but shall not be less than the distance specified in 780 CMR 2114.0 and the mechanical code listed in *Appendix A*, from all flues, chimneys and fireplaces, and six inches (152 mm) away from flue openings.

2305.13 Wall sheathing: Except as provided for in 780 CMR 1405.3 for weatherboarding or where stucco construction that complies with 780 CMR 2506.0 is installed, all enclosed buildings shall be sheathed with one of the materials of the nominal thickness specified in Table 2305.13 or any other approved material of equivalent strength and durability.

Table 2305.13
MINIMUM THICKNESS OF WALL
SHEATHING

Sheathing type	Minimum thickness	Maximum shear wall stud spacing ^a
Wood boards	¾ inch	24 inches on center
Fiberboard	7/16 inch	16 inches on center
Wood structural panel	In accordance with Table 2307.3.5	
2-M-1 or 2-M-W Particleboard	In accordance with Table 2308.5(2)	
Gypsum sheathing	½ inch	16 inches on center
Gypsum wallboard	½ inch	24 inches on center
Reinforced cement mortar	1 inch	24 inches on center

Note a. 1 inch = 25.4 mm.

2305.13.1 Wood structural panel wall bracing: In buildings assigned to Seismic Performance Category D, where wood structural panel sheathing is installed structurally as covering on the exterior of outside walls, such sheathing shall be of the exterior type. Where used elsewhere

THE MASSACHUSETTS STATE BUILDING CODE

structurally, wood structural panel sheathing shall be bonded by intermediate or exterior glue.

2305.13.2 Paper-backed lath sheathing: In occupancies in Use Group R-3 and one-story commercial buildings with brick or similar veneers, the sheathing shall conform to 780 CMR 2305.13 or shall consist of a layer of paper-backed lath complying with 780 CMR 2505.0 and a one-inch (25 mm) intermediate space which shall be mortar filled as each course of veneering is applied.

2305.14 Flooring: The flooring of wood frame construction shall be of adequate strength and

2305.14.2 Bridging: In all floor, *attic* and roof framing, except as hereafter noted, there shall not be less than one line of bridging for each eight feet (or 2450 mm) of span. The bridging shall consist of not less than one-inch by three-inch lumber, double nailed at each end, or of equivalent metal bracing of equal rigidity. A line of bridging shall also be required at supports where adequate lateral support is not otherwise provided. Midspan bridging is not required for floor, *attic* or roof framing in occupancies in Use Groups R-2 and R-3, except where the joist depth exceeds 12 inches nominal or where the minimum uniformly distributed *live load* exceeds 40 psf (195 kg/m²).

2305.15 Roof spans: Design stresses of rafters shall be determined in accordance with AFPA NDS listed in Appendix A. Metal-plate-connected roof trusses shall be designed in accordance with TPI *Design Specifications for Metal Plate Connected Wood Trusses* and AFPA NDS listed in **Appendix A**, and shall be braced to prevent rotation and provide lateral stability.

2305.15.1 Roof decking and sheathing: Roof deck sheathing shall consist of not less than 7/8-inch boards, wood structural panel of the thickness specified in 780 CMR 2307.3, *particleboard* of the grade and thickness specified in 780 CMR 2308.4, or other approved materials of equivalent

stiffness to support required *loads* and, where necessary for strength and for lateral support of the building, subflooring shall be provided.

2305.14.1 Floor spans: Design stresses of floor joists shall be determined in accordance with AFPA NDS listed in **Appendix A**. Metal-plate-connected floor trusses shall be designed in accordance with TPI *Design Specifications for Metal Plate Connected Parallel Chord Wood Trusses* and AFPA NDS listed in **Appendix A**.

strength and rigidity. Where open deck sheathing is used on pitched roofs, such sheathing shall consist of not less than one-inch by four-inch roofers spaced not more than six inches (152 mm) on center, or of material of equivalent strength and rigidity.

2305.16 Foundation anchorage: Wall sill plates, minimum of two-inch by four-inch members, shall be sized and anchored to foundation walls or piers and at intermediate intervals as required to resist wind uplift. Foundation anchorage shall be provided by the installation of anchor bolts or other approved anchoring method. Anchor bolts shall be of a minimum diameter of 1/2 inch. The bolts shall be embedded in foundations to a depth of not less than eight inches (203 mm) of cast-in-place concrete, and not less than 15 inches (381 mm) in grouted unit masonry. There shall be a minimum of two anchor bolts per section of plate and anchor bolts shall be placed 12 inches (305 mm) from the end of each section of plate, with intermediate bolts spaced a maximum of six feet (1829 mm) on center for one- and two-story buildings and not more than four feet (1219 mm) on center for buildings over two stories in height.

Exception: *Agricultural storage buildings which are intended only for incidental human occupancy, are permitted to have maximum*

intermediate bolt spacings of eight feet (or 2450 mm).

2305.17 Fire cuts: All wood structural members which frame into masonry walls shall conform to 780 CMR 2305.6.4.

780 CMR 2306.0 SEISMIC REQUIREMENTS FOR WOOD AND TIMBER

2306.1 General: All buildings for which a seismic analysis is required, in accordance with 780 CMR 1612.2, and which are constructed partially or wholly of wood or wood-based materials shall be designed in accordance with the provisions of 780 CMR 2306.0 and 780 CMR 2305.0.

2306.2 Definitions: The following words and terms shall apply to the provisions of 780 CMR 2306.0 and have the following meanings:

Blocked diaphragm: A diaphragm in which all sheathing edges not occurring on a framing member are supported on and connected to blocking.

2306.4.2 Wood shear panels: Wood shear panels shall comply with 780 CMR 2306.4.2.1 through 2306.4.2.6. Diaphragm construction shall comply with 780 CMR 2306.4.3. Shear wall construction shall comply with 780 CMR 2306.4.4. The construction of wood shear panels shall comply with 780 CMR 2306.4.5 for diagonally sheathed lumber shear panels, 780 CMR 2306.4.6 for wood structural panel sheathed shear panels, 780 CMR 2306.4.7 for *particleboard* sheathed shear panels, or 780 CMR 2306.4.8 for other shear panel sheathing.

2306.4.2.1 Framing members: All framing members stilled in shear panel construction shall be at least two inches nominal in thickness. Boundary members, and chords in diaphragms

Diaphragm: A horizontal or nearly horizontal system designed to transmit lateral forces to the vertical elements of the seismic-resisting system.

Wood shear panel: A wood floor, roof or wall component sheathed to act as a shear wall or diaphragm.

2306.3 Strength of members and connections: The allowable *load* capacities of 780 CMR 2306.0 are to be utilized with allowable stress design *load* combinations.

2306.4 Engineered timber construction: Where seismic analysis is required in accordance with 780 CMR 1612.2, the proportioning and design of wood systems, members and connections shall be in accordance with 780 CMR 2306.4 and AFPA NDS listed in *Appendix A*.

2306.4.1 Column framing requirements: All wood columns shall be provided with full end support. Columns shall be provided with adequate support to maintain stability. Positive connections shall be provided to resist uplift and lateral displacement.

and shear walls and collectors transferring forces to such elements shall be designed and detailed for the axial forces. Boundary members shall be connected at all corners.

2306.4.2.2 Opening details: Openings in shear panels shall be designed and detailed to transfer the shear and axial forces induced by the discontinuity created by the opening and the details shall be shown on the approved plans.

2306.4.2.3 Connection and anchorage details: Positive connections and anchorages, capable of resisting the design forces, shall be provided between the shear panel and the attached components. Concrete or masonry wall anchorage shall not be accomplished by

THE MASSACHUSETTS STATE BUILDING CODE

installation of toe nails, or nails subject to withdrawal and wood ledgers shall not be installed in cross-grain bending or tension.

2306.4.2.4 Torsion: The diaphragms in buildings having torsional irregularity, where the lateral stiffness ratio of the structural members is greater than four to one, or in buildings with one line of resistance in either orthogonal direction, shall be sheathed with diagonal boards or wood structural panels. The length of the diaphragm normal to the soft side shall not exceed 25 feet (or 7600 mm) nor shall the diaphragm length-to-width ratio exceed 1.0 for one-story buildings or 0.67 for buildings over one story in height.

Exception: Where calculations demonstrate that the diaphragm deflections will be tolerated, the length limitation of 25 feet (or 7600 mm) does not apply and the length-to-width ratio of 1.5 is permitted for diaphragms sheathed with single diagonal boards; and a ratio of 2.0 is permitted where sheathed with double diagonal boards or wood structural panels.

2306.4.2.5 Panel height-to-width ratio: The width of a shear panel in a diaphragm or shear wall shall not be less than two feet and the h/w ratio of a shear wall shall not be greater than two, where h is the height of a shear panel or shear wall and w is the width of a shear panel or shear wall.

2306.4.3 Diaphragms: Wood diaphragms shall not be installed to resist torsional forces induced by concrete or masonry construction in buildings of Seismic Performance Category D which are more than two stories in height.

2306.4.3.1 Ties and splices: Diaphragm sheathing shall not be installed as the ties and splices required by 780 CMR 1612.3.6.1.1 and 780 CMR 1612.3.6.1.2.

Exception: *Diaphragm sheathing in buildings of Seismic Performance Category C.*

2306.4.4 Shear walls: Shear wall construction shall comply with the requirements of 780 CMR 2306.4.4

2306.4.4.1 Design shear increases: The design shear capacity is permitted to be doubled where identical materials are applied to both sides of the wall. Where the shear capacities of the materials are not equal, the allowable shear shall be considered to be equal to either the shear for the side with the higher capacity or twice the shear for the side with the lower capacity.

2306.4.4.2 Material limitations: Shear walls shall be sheathed with wood structural panels in Seismic Performance Category C and D buildings.

Exceptions:

- 1. In Seismic Performance Category C buildings:** *particleboard*, gypsum sheathing, gypsum wallboard, fiberboard and wire lath and cement plaster shear walls are permitted.
- 2. In Seismic Performance Category D buildings:** *particleboard*, gypsum sheathing, gypsum wallboard and wire lath and cement plaster shear walls in one-story buildings and the top story of buildings two stories or more in height are permitted

2306.4.5 Diagonally sheathed lumber shear panels: Diagonally sheathed lumber shear panels shall be nailed in accordance with Table 2306.4.5.

Table 2306.4.5
DIAGONALLY SHEATHED SHEAR PANEL
NAILING SCHEDULE

Sheathing		
	Nailing to intermediate	Nailing at the shear

nominal dimension	and end-supported studs		panel boundaries	
	Number of nails per board and nail size			
	Common nails	Box nails	Common nails	Box nails
1" x 6"	(2) 8d	(3) 8d	(3) 8d	(5) 8d

2306.4.5.1 Single diagonal construction: Single diagonally sheathed lumber shear panels shall be constructed of minimum one-inch-thick nominal sheathing boards laid at an angle of approximately 45 degrees (0.78 rad) to the supports. The shear capacity for single diagonally sheathed lumber shear panels of Southern pine or Douglas fir-larch shall not exceed 200 pounds per lineal foot (298 kg/m) of width. The shear capacities shall be adjusted by a reduction factor of 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49 and a reduction factor of 0.65 for species with a specific gravity of less than 0.42, as contained in AFPA NDS listed in *Appendix A*.

2306.4.5.1.1 End joints: Joints in adjacent boards shall be separated by not less than one stud or joist space and there shall not be less than two boards between joints on the same support.

2306.4.5.1.2 Two-inch nominal lumber: Wood shear panels made up of two-inch-thick diagonal lumber sheathing fastened with 16d nails shall be designed with the same shear capacities as shear panels using one-inch boards fastened with 8d nails, provided that there are not splices in adjacent boards on the same support and the supports are not less than four inches nominal in depth or three inches nominal in thickness.

2306.4.5.2 Double diagonal construction: Double diagonally sheathed lumber shear panels shall be constructed of two layers of diagonal

2" x 6"	(2) 16d	(3) 16d	(3) 16d	(5) 16d
2" x 8"	(3) 16d	(4) 16d	(4) 16d	(6) 16d

sheathing boards laid at 90 degrees (1.57 rad) to each other on the same face of the supporting members. Each chord shall be considered as a beam loaded with uniform *load* per foot equal to 50% of the unit shear due to diaphragm action. The *load* shall be assumed as acting normal to the chord in the plane of the diaphragm in either direction. The span of the chord or portion thereof shall be the distance between framing members of the diaphragm such as the joists, studs and blocking that serve to transfer the assumed *load* to the sheathing. The shear capacity of double diagonally sheathed diaphragms of Southern pine or Douglas fir-larch, shall not exceed 600 pounds per lineal foot (893 kg/m) of width. The shear capacity shall be adjusted by a reduction factor of 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49 and a reduction factor of 0.65 for species with a specific gravity of less than 0.42 as contained in AFPA NDS listed in *Appendix A*.

2306.4.6 Wood structural panel shear panels: The design and shear capacity of wood structural panel shear panels shall be in accordance with 780 CMR 2306.4.6.1 for diaphragms and 780 CMR 2306.4.6.2 for shear walls, or shall be calculated by using the nail strengths in AFPA NDS and the wood structural panel shear capacities as given in DOC PS 1 listed in *Appendix A*.

Shear panels shall be constructed of wood structural panels manufactured with exterior glue not less than four feet by eight feet, except at boundaries and changes in framing. Wood structural panels shall be designed to resist shear

THE MASSACHUSETTS STATE BUILDING CODE

only, and chords, collector members and boundary members shall be designed to transfer the axial forces. Boundary members shall be connected at all comers. Wood structural panels less than 12 inches (305 mm) wide shall be blocked.

2306.4.6.1 Wood structural panel floor and roof diaphragm construction: The nail size and spacing at diaphragm boundaries and at the edges of each sheet of wood structural panel shall be provided as shown in Table 2306.4.6.1 and Figure 2306.4.6.1, and by the provisions of 780 CMR 2306.4.6.1.1 through 2306.4.6.1.4. Nails of the same size shall be placed along all intermediate framing members at 12 inches (305 mm) on center.

2306.4.6.1.1 Other wood species: Shear capacities for fasteners in framing members of other wood species, shall be calculated by multiplying the shear capacities for Structural I panels by 0.82 for species with a specific gravity of 0.42 and greater but less than 0.49 and 0.65 for species with a specific gravity of

2306.4.6.1.4 Panels 1 $\frac{1}{2}$ inch thick: Unblocked 1 $\frac{1}{2}$ -inch panels with tongue-and-groove edges are permitted to use the blocked diaphragm shear capacities for 19/32-inch minimum nominal panel thickness values, where one-inch by $\frac{1}{2}$ -inch crown by No. 16 gage staples are driven through the tongue-and-groove edges $\frac{1}{2}$ inch (10 mm) from the panel edge so as to penetrate the tongue. Staples shall be spaced at one-half the boundary nail spacing for Cases I and 2 and at $\frac{1}{2}$ the boundary nail spacing for Cases 3, 4, 5 and 6.

2306.4.6.2 Wood structural panel shear wall construction: The nail size and spacing at the edge of each wood structural panel shall be provided as shown in Table 2306.4.6.2 and by the provisions of 780 CMR 2306.4.6.2.1 through 2306.4.6.2.3. For $\frac{1}{2}$ -inch and $\frac{7}{16}$ -inch

less than 0.42, as contained in AFPA NDS listed in *Appendix A*.

2306.4.6.1.2 Framing and panel layout: The orientation of the structural framing and wood structural panels shall comply with Case I, 2, 3, 4, 5 or 6 of Table 2306.4.6.1 and with Figure 2306.4.6.1. For blocked diaphragms, the maximum shear for Cases 3, 4, 5 and 6 shall not exceed 1,200 pounds per lineal foot (1787 kg/m).

2306.4.6.1.3 Fastener spacings of two and 2 $\frac{1}{2}$ inches: Where either two-inch (51 mm) or 2 $\frac{1}{2}$ -inch (64 mm) fastener spacings are installed with two-inch-wide framing members in accordance with Table 2306.4.6.1, the framing member adjoining panel edges shall be three inches nominal in width and nails at panel edges shall be placed in two lines.

panels, installed on studs spaced 24 inches (610 mm) on center, nails shall be spaced at six inches (152 mm) on center along intermediate framing members. For all other thicknesses and spacing of studs, intermediate framing members shall have nails of the same size spaced at 12 inches (305 mm) on center. All panel edges shall be backed with two-inch or wider framing members.

Table 2306.4.6.1

**HORIZONTAL WOOD STRUCTURAL PANEL DIAPHRAGM ALLOWABLE SHEAR
WITH FRAMING MEMBERS OF DOUGLAS FIR-LARCH OR SOUTHERN PINE**

Panel grade	Fastener type	Fastner minimum penetration in framing (inches)	specified panel thickness (inch)	Minimum nominal width of framing member (inches)	Lines of fasteners	Allowable shear (pounds per foot) ^b											
						Blocked diaphragms ^a								Unblocked diaphragms ^a			
						Fastener spacing (inches) at diaphragm boundaries (all cases), at continuous panel edges parallel to load (Cases 3 and 4), and at all panel edges (Cases 5 and 6)								Fastener spacing at 6 inches at supported edges			
						6	4		2½		2		Case 1	Cases 2, 3, 4, 5 and 6			
						Spacing (inches) per line at other panel edges (cases 1,2,3 and 4)											
						6	6	4	4	3	3	2					
Structural 1	6d common	1¼	5/16	2 3	1 1	185 210	250 280		375 420		420 475		165 185	125 140			
	8d common	1½	?	2 3	1 1	270 300	360 400		530 600		600 675		240 265	180 200			
	10d common	1?	15/32	2 3	1 1	320 360	425 480		640 720		730 820		285 320	215 240			
	10d common	1?	23/32	3 4 4	2 2 3		650 755 940	870 980 1,305	940 1,080 1,375	1,230 1,410 1,810							
	14-gage staples	2	23/32	3 4	2 3		600 840	600 900	840 1,140	900 1,350	1,040 1,440	1,200 1,800					
C-D, C-C and other similar grades	6d common	1¼	5/16	2 3	1 1	170 109	225 250		335 380		380 430		150 170	110 125			
			?	2 3	1 1	185 210	250 280		375 420		420 475		165 185	125 140			
	8d common	1½	?	2 3	1 1	240 270	320 360		480 540		545 610		215 240	160 180			
			7/16	2 3	1 1	255 285	340 380		505 570		575 645		230 255	170 190			
			15/32	2 3	1 1	270 300	360 400		530 600		600 675		240 265	180 200			
C-D, C-C and other similar grades	10d common	1?	15/32	2 3	1 1	290 325	385 430		575 650		655 735		255 290	190 215			
			19/32	2 3	1 1	320 360	425 480		640 720		730 820		285 320	215 240			
							645	870	935	1,225							

3 2

780 CMR: STATE BOARD OF BUILDING REGULATIONS AND STANDARDS

THE MASSACHUSETTS STATE BUILDING CODE

		23/32	4	2		750	980	1,075	1,395				
			4	3		935	1,305	1,390	1,510				
14-gage staples	2		3	2		600	600	820	900	1,020	1,200		
		23/32	4	3		820	900	1,120	1,350	1,400	1,510		

Note a. For sheathing and framing configuration Cases 1 through 6, see Figure 2306.4.6.1.

Note b. 1 inch = 25.4 mm; 1 pound per foot = 1.489 jg/m.

Figure 2306.4.6.1
SHEATHING AND FRAMING CONFIGURATIONS

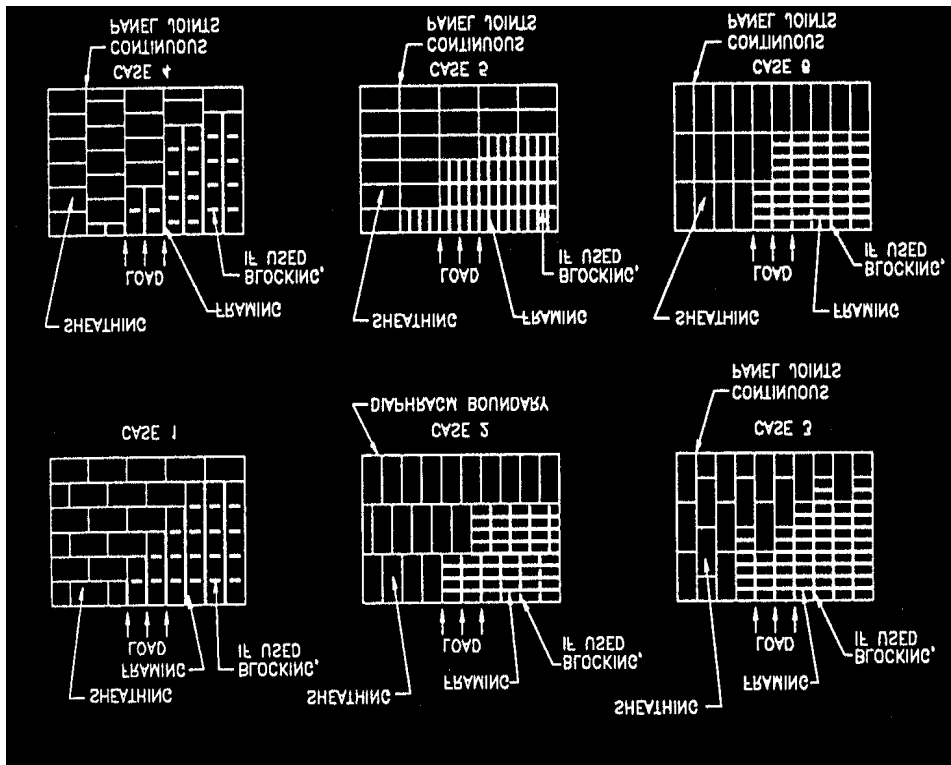


Table 2306.4.6.2
ALLOWABLE SHEAR FOR WOOD STRUCTURAL PANEL SHEAR WALLS WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE FOR WIND OR SEISMIC LOADING

Panel Grade	Minimum nominal panel thickness (inch)	Minimum nail penetration in framing (inches)	Panels applied direct to framing					Panels applied over 1/2-inch or 3/4-inch gypsum sheathing				
			Nail Size (common or galvanized box)	Allowable shear (pounds per foot) ^a based on nail spacing at panel edges (inches)				Nail size (common or galvanized box)	Allowable shear (pounds per foot) ^a based on nail spacing at panel edges (inches)			
				6	4	3	2		6	4	3	2
Structural I	5/16	1 1/4	6d	200	300	390	510	8d	200	300	390	510
	?	1 1/2	8d	230	360	460	610	10d				
	7/16			255	395	505	670					
	15/32			280	430	550	730		280	430	550	730
	15/32	1 3/4	10d	340	510	665	870	-	-	-	-	-
Sheathing, Plywood siding,	5/16	1 1/4	6d	180	270	350	450	8d	180	270	350	450
	?			200	300	390	510		200	300	390	510
	?			220	320	410	530		260	380	490	640

THE MASSACHUSETTS STATE BUILDING CODE

	7/16			240	350	450	585					
	15/32			260	380	490	640					
	15/32			310	460	600	770					
	19/32	1?	10d	340	510	665	870	-	-	-	-	-
			Nail size (galvanized casing)					Nail size (galvanized casing)				
Plywood siding	5/16	1¼	6d	140	210	275	360	8d	140	210	275	360
	?	1½	8d	160	240	310	410	10d	160	240	310	410

Note a. 1 inch = 25.4 mm; 1 pound per foot = 1.489 kg/m.

2306.4.6.2.1 Other wood species: Shear capacities for fasteners in framing members of other wood species shall be calculated by multiplying the shear capacities for Structural I panels by 0.82 for species with a specific

2306.4.6.2.2 Three-inch nominal width framing: Framing shall be three inches nominal or wider and the nails shall be staggered where nails are spaced two inches (51 mm) on center or where 10d nails having a penetration into framing of more than 1? inches (41 mm) are used with a three-inch (76 mm) nail spacing.

2306.4.6.2.3 Panels ? inch and 7/16 inch thick: The shear capacity for ?-inch and 7/16-inch panels applied direct to framing with 8d nails is permitted to be increased to the values shown for 15/32-inch panels with the same nailing where the framing studs are spaced a maximum of 16 inches (406 mm) on center or the panels are applied with the long dimension across the studs.

Shear capacity for ?-inch and 7/16-inch panels shall be as indicated in Table 2306.4.6.2.

2306.4.7 Particleboard shear panels: The design shear capacity of *particleboard* panels shall be in accordance with 780 CMR 2306.4.7.1 for diaphragms and 780 CMR 2306.4.7.2 for shear walls.

gravity of 0.42 or greater but less than 0.49 and 0.65 for species with a specific gravity of less than 0.42, as contained in AFPA NDS listed in **Appendix A**.

Shear panels shall be constructed with *particleboard* sheets not less than four feet by eight feet, except at boundaries and changes in framing, *particleboard* panels shall be designed to resist shear only, and chords, collector members and boundary members shall be designed to transfer the axial forces. Boundary members shall be connected at all corners. *Particleboard* panels less than 12 inches (305 mm) wide shall be blocked.

2306.4.7.1 Particleboard floor and roof diaphragm construction: The nail size and spacing at diaphragm boundaries and the edges of each sheet of *particleboard* shall be as shown in Figure 2306.4.6.1 and Table 2306.4.7.1 and shall be designed in accordance with the provisions of this section. Nails of the same size shall be placed along all intermediate framing members at 12 inches (305 mm) on center.

2306.4.7.1.1 Other wood species: Shear capacities for fasteners in framing members of other wood species shall be calculated by multiplying the shear capacities by 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49, and by 0.65 for

species with a specific gravity of less than 0.42, as contained in AFPA NDS listed in

Appendix A.

Table 2306.4.7.1

ALLOWABLE SHEAR FOR PARTICLEBOARD DIAPHRAGMS WITH FRAMING MEMBERS OF DOUGLAS FIR-LARCH OR SOUTHERN PINE FOR SEISMIC LOADING

Panel grade	Common nail size	Minimum nail penetration in framing (inches)	Minimum nominal panel thickness (inch)	Minimum nominal width of framing member (inches)	Allowable shear (pounds per foot) ^b					
					Blocked Diaphragms ^a				Unblocked diaphragms ^a	
					Nail spacing (inches) at diaphragm boundaries (all cases), at continuous panel edges parallel to load (Cases 3 & 4), and all panel edges (Cases 5 & 6)				Nails spaced 6 inches maximum at supported edges	
					6	4	2½	2	Case 1 (No unblocked edges or continuous joints parallel to load)	All other configurations (Cases 2, 3, 4, 5 & 6)
					Nail spacing (inches) at other panel edges (Cases 1, 2, 3 & 4)					
					6	6	4	3		
2-M-W	6d	1¼	5/16	2	170	225	335	380	150	110
				3	190	250	380	430	170	125
			?	2	185	250	375	420	165	125
				3	210	280	420	475	185	140
	8d	1½	?	2	240	320	480	545	215	160
				3	270	360	540	610	240	180
			7/16	2	255	340	505	575	230	170
				3	285	380	570	645	255	190
			½	2	270	360	530	600	240	180
				3	300	400	600	675	265	200
	10d	1?	½	2	290	385	575	655	255	190
				3	325	430	650	735	290	215
?			2	320	425	640	730	285	215	
			3	360	480	720	820	320	240	
2-M-3	10d	1?	¾	2	320	425	640	730	285	215
				3	360	480	720	820	320	240

Note a. For sheathing and framing configuration Cases 1 through 6, see Figure 2306.4.6.1

Note b. 1 inch = 25.4 mm; 1 pound per foot = 1.489 kg/m.

THE MASSACHUSETTS STATE BUILDING CODE

2306.4.7.1.2 Framing and panel layout:

The orientation of the structural framing and *particleboard* panels shall comply with Figure 2306.4.6.1 and Case 1, 2, 3, 4, 5 or 6 in Table 2306.4.7.1.

2306.4.7.1.3 Fastener spacings of two and 2½ inches: Where either two-inch (51 mm) or 2½-inch (64 mm) fastener spacings are installed with 2-inch-wide framing members in accordance with Table 2306.4.7.1, the framing member adjoining panel edges shall be three inches nominal in width and nails at panel edges shall be placed in two lines.

2306.4.7.1.4 Panel edge framing: Framing at adjoining panel edges shall be three inches nominal or wider and nails shall be staggered where 10d nails having penetration into framing of more than 1½ inches (41 mm) are spaced three inches (76 mm) or less on center.

2306.4.7.2 Particleboard shear wall construction: The required nail size and spacing in Table 2306.4.7.2 apply to panel edges only. All panel edges shall be backed with two-inch nominal or wider framing. Sheets are permitted to be installed either horizontally or vertically. For ¾-inch *particleboard* sheets installed with the long dimension parallel to studs spaced 24 inches (610 mm) on center, nails shall be spaced at six inches (152 mm) on center along intermediate framing members. For all other conditions, nails of the same size shall be spaced at 12 inches (305 mm) on center along intermediate framing members.

2306.4.7.2.1 Other wood species: Shear capacities for fasteners in framing members of other wood species, shall be calculated by multiplying the shear capacities by 0.82 for species with a specific gravity of 0.42 or

greater but less than 0.49 and 0.65 for species with a specific gravity of less than 0.42 as contained in AFPA NDS listed in *Appendix A*.

2306.4.7.2.2 Three-inch nominal width framing: Framing shall be three inches nominal or wider and the nails shall be staggered where nails are spaced two inches (51 mm) on center or where 10d nails having a penetration into framing of more than 1½ inches (41 mm) are installed with a three-inch (76 mm) nail spacing.

2306.4.7.2.3 Particleboard of ¾ and 7/16 inch thicknesses: The shear capacities for ¾-inch and 7/16-inch *particleboard* applied direct to framing with 8d nails, are permitted to be increased to the ½-inch *particleboard* shear capacities of Table 2306.4.7.2 where the framing studs are spaced a maximum of 16 inches (406 mm) on center or the *particleboard* is applied with the long dimension perpendicular to the studs.

2306.4.7.2.4 Double-sided wall: Where *particleboard* is applied to both faces of a wall and the nail spacing is less than six inches (152 mm) on center on either side, panel joints shall be offset to be placed on different framing members, or framing shall be three inches nominal or thicker and nails on each side shall be staggered.

2306.4.8 Shear panels sheathed with other materials: Wood stud walls sheathed with lath and plaster, gypsum sheathing board or gypsum wallboard, constructed in accordance with 780 CMR 2502.0, or fiberboard sheathing constructed in accordance with 780 CMR 2309.8, shall be permitted to be used to resist earthquake forces in wood frame buildings. Nails shall be spaced at least ¾ inch (10 mm) from the edges and ends of boards and panels.

The maximum height-to-width ratio shall be
1.5. The shear capacities utilized in design shall

not be cumulative with the shear capacities of
other materials applied to the same wall.

Table 2306.4.7.2
ALLOWABLE SHEAR FOR PARTICLEBOARD SHEAR WALLS WITH FRAMING OF
DOUGLAS FIR-LARCH OR SOUTHERN PINE FOR SEISMIC LOADING

Panel grade	Minimum nominal panel thickness (inch)	Minimum nail penetration in framing (inches)	Panels applied direct to framing					Panels applied over 1/2-inch gypsum sheathing				
			Nail size (common or galvanized box)	Allowable shear (pounds per foot) ^a nail spacing at panel edges (inches)				Nail size (common or galvanized box)	Allowable shear (pounds per foot) ^a nail spacing at panel edges (inches)			
				6	4	3	2		6	4	3	2
2-M-W	⁵ / ₁₆	1¼	6d	180	270	350	450	8d	180	270	350	450
	?			200	300	390	510		200	300	390	510
	?	1½	8d	220	320	410	530	10d				
	⁷ / ₁₆			240	350	450	585					
	½			260	380	490	640		260	380	490	640
	½	1?	10d	310	460	600	770	NA ^b	NA ^b	NA ^b	NA ^b	NA ^b
	?			340	510	665	870		NA ^b	NA ^b	NA ^b	NA ^b

Note a. 1 inch = 25.4 mm; 1 pound per foot = 1.489kg/m.

Note b. NA = Not Applicable

780 CMR 2307.0 WOOD STRUCTURAL PANELS

2307.1 Standards: All wood structural panels that are utilized structurally shall comply with the requirements of DOC PS 1, DOC PS 2, HPMA HP and HPMA HP-SG listed in *Appendix A* for the type, grade and span rating or species group of wood structural panels involved, and shall be so identified by an *approved agency*.

2307.2 Types: Wood structural panels for interior installations shall be of the interior type, moisture-resistant type or exterior type. Wood structural panels for exterior installations shall be of the exterior-waterproof type, except that wood structural panel roof sheathing exposed to the outdoors on the underside is permitted to be of the interior type and bonded with exterior glue. Exterior wood structural panels shall not be applied directly to the framing as a siding unless the wood structural panel has a minimum nominal thickness of ? inch. Joints shall occur over framing members, unless wood or wood structural panel sheathing is used or joints are lapped

horizontally a minimum of 1 1/2 inches (38 mm) or otherwise made waterproof in an approved manner. Where a wood structural panel is utilized as lapped siding without sheathing, the wall framing to which such wood structural panel is attached shall be diagonally braced.

2307.3 Spans: The maximum spans for wood structural panel sheathing shall be limited by the allowable stresses and deflections for the design *live load*, but shall not be greater than the spans specified in Tables 2307.3.1(1), 2307.3.1(2), 2307.3.3 and 2307.3.5. The spans specified in these tables shall apply to wood structural panels not treated with fire retardant chemicals. The design criteria for fire retardant-treated wood structural panels shall be provided by valid research reports from approved sources.

2307.3.1 Floor and roof sheathing: Allowable spans for floor and roof sheathing shall be as specified in Tables 2307.3.1(1) and 2307.3.1(2). The values in Table 2307.3.1(1) apply to Structural I, C-D and C-C sheathing and single

floor grades only, and are limited to the spans shown because of the possible effects of concentrated *loads*.

2307.3.2 Floor sheathing: Edges of wood structural panel floor sheathing shall have approved tongue-and-groove joints or shall be supported with blocking, unless ¼-inch minimum thickness underlayment or 1½ inches (38 mm) of approved cellular or lightweight concrete is

installed, or unless the finish floor is of ¾-inch wood strip. The allowable uniform *load* based on a deflection of 1/360 of the span is 100 pounds per square foot (psf) (488 kg/m²) at maximum span.

2307.3.3 Wood structural panel combination subfloor underlayment: Allowable spans for combination subfloor underlayment shall be as specified in Table 2307.3.3.

THE MASSACHUSETTS STATE BUILDING CODE

Table 2307.3.1(1)

**ALLOWABLE SPANS AND LOADS FOR WOOD STRUCTURAL PANEL SHEATHING
GRADES AND SINGLE FLOOR GRADES CONTINUOUS OVER TWO OR MORE SPANS
WITH LONG DIMENSION PERPENDICULAR TO SUPPORTS^{a,b,g}**

Sheathing grades		Roof				Floor
Span rating ^h	Panel thickness (inch) ⁱ	Maximum span (inches) ⁱ		Load (pounds per square foot) ⁱ		Maximum span (inches) ⁱ
Roof/floor span		With edge support ^c	Without edge support	Total load	Live load	
12/0	5/16	12	12	40	30	0
16/0	5/16, ?	16	16	40	30	0
20/0	5/16, ?	20	20	40	30	0
24/0	? , 7/16, 1/2	24	20 ^d	40	30	0
24/16	7/16, 1/2	24	24	50	40	16
32/16	15/32, 1/2, ?	32	28	40	30	16 ^f
40/20	23/32, ? , 3/4, ?	40	32	40	30	20 ^{e,f}
48/24	23/32, 3/4, ?	48	36	45	35	24
Single floor grades		Roof				Floor
Span rating ^h	Panel thickness (inches) ⁱ	Maximum span (inches) ⁱ		Load (pounds per square foot) ⁱ		Maximum span (inches) ⁱ
		With edge support ^c	Without edge support	Total load	Live load	
16 o.c.	19/32, ?	24	24	50	40	16 ^f
20 o.c.	19/32, ? , 3/4	32	32	40	30	20 ^{e,f}
24 o.c.	23/32, 3/4	48	36	35	25	24
32 o.c.	? , 1	48	40	50	40	32
48 o.c.	1 3/32, 1?	60	48	50	40	48

Note a. The allowable loads were determined based on a dead load of 10 psf. If the dead load exceeds 10 psf, then the live load shall be reduced accordingly.

Note b. For limitations on the applicability of this table to wood structural panel grade, see 780 CMR 2307.3.1

Note c. Tongue-and-groove edges, panel edge clips (one midway between each support, except two equally spaced between supports 48 inches on center), lumber blocking, or other. Only lumber blocking shall satisfy blocked diaphragm requirements.

Note d. 24 inches for 1/2-inch panels.

Note e. Maximum framing space shall be 24 inches on center for floors where 1 1/2 inches of cellular or lightweight concrete is applied over the panels.

Note f. Maximum frame spacing shall be 24 inches on center where 3/4-inch wood strip flooring is installed a right angles to joist.

Note g. Shall apply only to panels 24 inches or wider.

Note h. Span rating shall appear on all panels in the construction grades listed in 780 CMR 2307.3.1.

Note i. 1 inch = 25.4 mm; 1 psf = 4.882 kg/m².

Table 2307.3.1(2)

**ALLOWABLE LOADS FOR WOOD STRUCTURAL PANEL ROOF SHEATHING
CONTINUOUS OVER TWO OR MORE SPANS AND LONG DIMENSION PARALLEL TO
SUPPORTS**

(Plywood Structural Panels are 5 ply/5 layer unless otherwise noted)^a

Panel grade	Thickness (inch) ^c	Span rating	Maximum span (inch) ^c	Load at maximum span (psf) ^c	
				Live	Total
	7/16	24/0, 24/16	24	20	30
Structural I sheathing	15/32	32/16	24	35 ^b	45 ^b
	1/2	32/16	24	40 ^b	50 ^b
	19/32, ?	40/20	24	70	80
	23/32, 3/4	48/24	24	90	100
Sheathing	7/16	24/0, 24/16	16	40	50
	15/32	32/16	24	20	25
	1/2	24/0, 32/16	24	25	30
	19/32	40/20	24	40 ^b	50 ^b
	?	32/16, 40/20	24	45 ^b	55 ^b
	23/32, 3/4	40/20, 48/24	24	60 ^b	65 ^b

Note a. Uniform load deflection limitations: 1/180 of span under live load plus dead load, 1/240 under live load only. Edges shall be blocked with lumber or other approved type of edge supports.

Note b. For composite and 4-ply plywood panels, load shall be reduced by 15 psf.

Note c. 1 inch = 25.4 mm; 1 psf = 4.882 kg/m².

Table 2307.3.3

**ALLOWABLE SPANS FOR WOOD
STRUCTURAL PANEL COMBINATION
SUBFLOOR UNDERLAYMENT^a PANELS
CONTINUOUS OVER TWO OR MORE
SPANS AND LONG PANEL DIMENSION
PERPENDICULAR TO SUPPORT
(THICKNESS IN INCHES)^d**

Identification	Maximum spacing of joists (inches)				
	16	20	24	32	48
Species groups ^b					
1	1/2	?	3/4	-	-
	?	3/4	?	-	-

2,3 4	3/4	?	1		
Single floor span rating ^c	16 o.c.	20 o.c.	24 o.c.	32 o.c.	48 o.c.

Note a. For limitations on the use of Table 2307.3.3 see 780 CMR 2307.3.4.

Note b. Applicable to all grades of sanded exterior-type plywood.

Note c. Applicable to underlayment grade and C-C (plugged) plywood and single-floor grade panels.

Note d. 1 inch = 25.4 mm; 1 psf = 4.882 kg/m².

THE MASSACHUSETTS STATE BUILDING CODE

2307.3.4 Limitations: Table 2307.3.3 is applicable to under layment grade, C-C (plugged), single-floor grade and all grades of sanded exterior-type plywood. For panels with a span rating of other than 48 inches (1219 mm) on center (o.c.), the allowable uniform *load* based on a deflection of 1/360 of the span is 100 psf (488 kg/m²). Panels with a span rating of 48 inches o.c. are limited to a total *load* of 65 psf (317 kg/m²) at the maximum span. Wood structural panel edges shall have approved tongue-and-groove joints or shall be supported with blocking, unless ¼-inch minimum thickness underlayment or 1½ inches (38 mm) of approved cellular or lightweight concrete is installed, or unless the finish floor is of ¾-inch wood strip. If wood strips are perpendicular to the supports, thicknesses or span ratings shown for 16-inch (406 mm) and 20-inch (508 mm) spans shall be used on 24-inch (610 mm) spans. Spans are limited to the values shown in Table 2307.3.3 because of the possible effects of concentrated *loads*.

2307.3.5 Vertical maximum stud spacing: Stud spacing for vertical sheathing shall be as specified in Table 2307.3.5.

Note a. Blocking of horizontal joints shall not be required.

Note b. Plywood sheathing ½ inch thick or less shall be applied with long dimension across studs.

Note c. Three-ply plywood panels shall be applied with long dimension across studs.

Note d. 1 inch = 25.4 mm.

2307.4 Stressed skin panel: For use in stressed skin or other prefabricated construction, wood structural panel design shall be determined by approved engineering analysis or by the tests prescribed in 780 CMR 1710.0 for prefabricated assemblies.

780 CMR 2308.0 PARTICLEBOARD

2308.1 Standards: *Particleboard* shall conform to ANSI A208.1 listed in **Appendix A**. *Particleboard* shall be identified by the grade mark or the certificate of inspection issued by an *approved agency*.

2308.2 Floor underlayment: Underlayment shall conform to Type 1-M-1 or sanded Type 2-M-W of ANSI A208.1 listed in **Appendix A**. Underlayment shall not be less than ¼ inch in thickness and shall be installed in accordance with the manufacturer's installation instructions.

2308.3 Subfloor or combination subfloor underlayment: Allowable spans and grades for combination subfloor underlayment shall be as specified in Table 2308.3. All panels shall be continuous over two or more spans and the tongue-and-groove panels shall be installed with the long dimension perpendicular to the supports. Uniform deflection limitation shall be 1/360 of the span under a minimum *load* of 100 psf. Edges shall have tongue-and-groove joints or shall be supported with blocking unless ¼-inch minimum thickness underlayment is installed, or unless the finish floor is of 25/32-inch wood strip.

Table 2307.3.5
ALLOWABLE STUD SPACING FOR WOOD
STRUCTURAL PANEL WALL SHEATHING

Panel span rating	Panel thickness (inch) ^d and construction	Maximum stud spacing (inches) ^d	
		Exterior coverings nailed to: ^a	
		Stud	Sheathing
12/0, 16/0, 20/0 or wall - 16 o.c.	5/16, ?	16	16 ^b
24/0, 24/16, 32/16 or wall - 24 o.c.	?, 7/16, 15/32, 1/2	24	24 ^c

Table 2308.3
ALLOWABLE SPANS FOR
PARTICLEBOARD SUBFLOOR AND
COMBINATION SUBFLOOR
UNDERLAYMENT^a

Grade	Thickness (inches)	Maximum spacing ^b of supports (inches)	
		Subfloor	Combination subfloor underlayment
2-M-W	1/2	16	-
	?	20	16
	3/4	24	24
2-M-3	3/4	20	20

Note a. For limitations on the use of Table 2308.3, see 780 CMR 2308.3

Note b. 1 inch = 25.4 mm.

2308.4 Roof sheathing: Allowable *loads* for roof sheathing shall be in accordance with the spans and grades specified in Table 2308.4. Panels shall be continuous over two or more spans. Uniform *load* deflection limitations shall be 1/180 of the span under *live load* plus *dead load* and 1/240 of the span under *live load* only. Edges of all ?-inch panels and edges of 7/16-inch panels with 24 inches (610 mm) o.c. spacing shall be supported with blocking or edge clips.

Table 2308.4
ALLOWABLE LIVE LOADS FOR
PARTICLEBOARD ROOF SHEATHING^{a,b}

Grade	Thickness (inches)	Maximum on-center spacing of supports (inches)	Live load (pounds per square foot)	Total load (pounds per square foot)
2-M-W	?	16	45	65
	7/16	16	105	105
	7/16	24	30	40
	1/2	16	110	150
	1/2	24	40	55

Note a. For limitations on the use of Table 2308.4, see 780 CMR 2308.4.

Note b. 1 inch = 25.4 mm; 1 pound per square foot = 4.882 kg/m².

2308.5 Siding and sheathing: Allowable spans and grades of *particleboard* siding and sheathing shall be as specified in Tables 2308.5(1) and 2308.5(2).

Table 2308.5(1)
ALLOWABLE SPANS FOR EXPOSED
PARTICLEBOARD PANEL SIDING

Grade	Stud spacing (inches)	Minimum thickness (inches)		
		Siding		Exterior ceilings and soffits
		Direct to studs	Continuous support	Direct to supports
2-M-W	16	?	5/16	5/16
	24	1/2	5/16	?
2-M-1 and 2-M-2	16	?	?	-
	24	3/4	?	-

Note a. 1 inch = 25.4 mm.

Table 2308.5(2)
ALLOWABLE SPANS FOR
PARTICLEBOARD WALL SHEATHING^a

Grade	Thickness (inches)	Stud spacing (inches) ^b	
		Siding nailed to studs	Sheathing under coverings parallel or perpendicular to studs
2-M-W	5/16	16	-
	?	24	16
	7/16	24	24
2-M-1 and 2-M-2	?	16	-
	1/2	16	16

Note a. Where not exposed to the weather and where the long dimension of the panel is parallel or perpendicular to the studs.

Note b. 1 inch = 25.4 mm.

780 CMR 2309.0 FIBERBOARD

2309.1 Standards: Insulating boards manufactured with wood or other vegetable fibers which are used as building boards for sheathing, roof decks, interior wall and ceiling finishes, roof insulation or sound

THE MASSACHUSETTS STATE BUILDING CODE

deadening, shall be vermin-proof, resistant to rot-producing fungi, water-repellent and shall conform to the strength and durability tests specified in ASTM C208 and C532 and AHA A 194.1 listed in **Appendix A**. Sheathing that is utilized structurally shall be so identified by an *approved agency*. Where required under the provisions of 780 CMR 7 or 8, the boards shall be *protected* or treated to develop the required fireresistance rating or flameresistance as determined by test.

2309.2 Jointing: To insure tight-fitting assemblies, edges shall be manufactured with square, shiplapped, beveled, tongue-and-groove or U-shaped joints.

2309.3 Roof insulation: Where used as roof insulation in all types of construction, fiberboards shall be *protected* with an approved roof covering.

2309.6 Insulating roof deck: Where used as roof decking in open beam construction, fiberboard insulating roof deck shall have a nominal thickness of not less than one inch.

2309.7 Siding: Hardboard siding shall comply with AHA A135.6 listed in **Appendix A**.

2309.8 Shear capacity: Wood stud walls sheathed with fiberboard sheathing are permitted to resist horizontal *loads* provided that such walls comply with Table 2309.8. Fiberboard shear walls shall not be utilized to resist horizontal *loads* from concrete or masonry walls.

Table 2309.8

**ALLOWABLE SHEAR CAPACITY FOR
WIND OR SEISMIC LOADING ON SHEAR
WALLS OF FIBERBOARD SHEATHING
BOARD**

Thickness and grade	Fastener type ^a	Shear capacity for 3-inch nail spacing around perimeter and 6-inch at intermediate studs (pounds per foot of wall) ^{b,c}
---------------------	----------------------------	-----------------------------------------------------------------------------------------------------------------------------------

2309.4 Wall insulation: Where installed and *firestopped* to comply with 780 CMR 7, fiberboards are permitted as wall insulation in all types of construction. In *fire wall* and *fire separation wall* constructions, unless treated to comply with 780 CMR 803.2 for Class I materials, the boards shall be cemented directly to the masonry or other noncombustible base and shall be protected with an approved noncombustible veneer anchored to the base without intervening air spaces.

2309.5 Drywall construction: Where fireresistance ratings are required, provision shall be made for interlocking, lapping or otherwise protecting the joints between adjacent boards to insure smoke and flame tightness.

1/2-inch Regular density	No. 11 ga. galv. Roofing nail 1 1/2" long 7/16" head	50
1/2-inch Intermediate density	No. 11 ga. galv. Roofing nail 1 1/2" long 7/16" head	60
25/32-inch Regular density	No. 11 ga. galv. Roofing nail 1 3/4" long 7/16" head	60

Note a. Fiberboard sheathing is permitted to be stapled using 16-gage galvanized staples 1 1/2 inch long for 1/2-inch sheathing and 1 1/2 inch long for 25/32-inch sheathing. Staples shall have a minimum crown of 7/16 inch and shall be spaced three inches o.c. at edges and six inches o.c. at studs.

Note b. Where studs are permitted to be located at 24 inches o.c., the shear capacity shall not be greater than 50 pounds per linear foot (plf).

Note c. 1 inch = 25.4 mm; 1 plf = 1.489 kg/m.

2309.8.1 Framing: Four-foot by eight-foot fiberboard sheathing shall be applied vertically to wood studs not less than two inches nominal in thickness spaced 16 inches (406 mm) on center.

Exception: Studs on 24-inch centers are permitted for 1/2-inch intermediate density

sheathing and 25/32-inch regular density sheathing in accordance with Table 2309.8.

2309.8.2 Nailing: Nailing shall be in accordance with Table 2309.8. Nails shall be spaced not less than $\frac{1}{2}$ inch (10 mm) from edges and ends of sheathing.

780 CMR 2310.0 FIRERETARDANT-TREATED WOOD

2310.1 Applications: Fireretardant-treated wood shall comply with 780 CMR 2310.0. Where Table 602 permits fireretardant-treated wood in Types 1 and 2 construction, fireretardant-treated wood shall not be utilized in loadbearing walls or in assemblies with a required fireresistance rating of more than one hour.

2310.2 General: Fireretardant-treated wood shall be any wood product which, when impregnated with chemicals by a pressure process in accordance with AWPAC20 or AWPAC27 listed in *Appendix A*, or other means during manufacture, shall have, when tested in accordance with ASTM E84 listed in *Appendix A*, a flame spread rating not greater than 25 when the test is continued for a period of 30 minutes, without evidence of significant progressive combustion; and the flame front shall not progress more than 10½ feet (3048 mm) beyond the centerline of the burner at any time during the test. Fireretardant-treated wood shall be dried to a moisture content of 19% or less for lumber and 15% or less for plywood before use.

2310.2.1 Strength modifications: Design values for untreated lumber, as specified in 780 CMR 2303.1, shall be adjusted for lumber that is pressure impregnated with fireretardant chemicals. Adjustments to the design values shall be based upon an approved method of investigation which takes into consideration the effects of the

anticipated temperature and humidity to which the fireretardant-treated wood will be subjected, the type of treatment and redrying procedures.

2310.2.2 Labeling: Fireretardant-treated lumber and plywood shall bear the *label* of *approved agencies* in accordance with 780 CMR 1704.3.2. Such *labels* shall indicate compliance with the appropriate treating standard in accordance with 780 CMR 2310.2 and indicate compliance with 780 CMR 2310.2.1.

2310.3 Exposure to weather: Where fireretardant-treated wood is to be exposed to the weather, the material shall be further identified to indicate that there is not an increase in the listed flame spread classification after being weathered in accordance with ASTM D2898 listed in *Appendix A*. Fireretardant-treated wood subjected to high-humidity conditions shall be identified to indicate that the treated wood has a moisture content of not over 28% when tested at 92% relative humidity in accordance with ASTM D3201 listed in *Appendix A*.

THE MASSACHUSETTS STATE BUILDING CODE

780 CMR 2311.0 NATURALLY DURABLE AND PRESERVATIVE-TREATED WOOD

2311.1 Required: Where protection of wood members is required because of exposure to soil or weather, protection shall be provided by using naturally durable or *preservative-treated* wood as required by 780 CMR 2311.0.

2311.2 Naturally durable wood: The term "naturally durable wood" refers to the heartwood of the following species with the exception that an occasional piece with corner sapwood is permitted if 90% or more of the width of each side on which it occurs is heartwood

Decay resistant: Redwood, cedar, black locust and black walnut.

Termite resistant: Redwood and Eastern red cedar

2311.3 Preservative-treated wood: The term "*preservative-treated* wood" refers to wood (including plywood) pressure treated with preservatives, that conforms to retention, penetration and other requirements applicable to the species, product, treatment and conditions of use in AWPA C1, C2 and C9 listed in *Appendix A*. Preservatives shall conform to AWPA P1/Pl3, P2, P5, P8 and P9 listed in *Appendix A*. Lumber and plywood in wood foundation systems shall conform to 780 CMR 1808.3.

2311.3.1 Identification: All piles, poles, lumber and plywood which are required to be *preservative-treated* shall bear the quality mark of an *approved agency* that maintains continuing supervision, testing and inspection over the quality of the product. Quality-control inspection agencies for *preservative-treated* wood shall be certified as to competency and performance by an approved organization. Said mark shall include the following information in a legible format: identification of the inspection agency; the

standard to which the product is treated; the identification of the treating plant; and the purpose for which the product has been treated. The mark shall be permanently affixed to each piece unless specifically waived by the code official.

2311.3.2 Moisture content: Where wood that is pressure treated with a water-borne *preservative* is used in enclosed locations where drying in service cannot readily occur, such wood shall be at a moisture content of 19% or less before being covered with insulation, interior wall finish, floor covering or other material.

2311.3.3 Fasteners: Fasteners for *preservative-treated* wood shall be of hot-dipped, zinc-coated, galvanized stainless steel, silicon bronze, copper or other corrosion-resistant materials. Fasteners for wood foundations shall be as required in AFPA TR7 listed in *Appendix A*.

2311.4 Wood used above ground: Wood installed above ground in the locations specified in 780 CMR 2311.4.1 through 2311.4.6 shall be naturally durable wood or *preservative-treated* wood that uses water-borne preservatives, and shall be treated in accordance with AWPA C2 or C9 listed in *Appendix A* for above-ground use.

2311.4.1 Joists and girders: Where wood joists or the bottom of a wood structural floor without joists are closer than 18 inches (457 mm), or wood girders are closer than 12 inches (305 mm), to the exposed ground in crawl spaces or unex-cavated areas located within the perimeter of the building foundation, the floor assembly (including posts, girders, joists and subfloor) shall be of approved naturally durable or *preservative-treated* wood.

2311.4.2 Framing: All wood framing members, including wood sheathing, which rest on exterior foundation walls and are less than eight inches (203 mm) from exposed earth shall be of approved naturally durable or *preservative-treated* wood.

2311.4.3 Sleepers and sills: Sleepers and sills on a concrete or masonry slab which is in direct contact with earth shall be of approved naturally durable or *preservative-treated* wood.

2311.4.4 Girder ends: The ends of wood girders entering exterior masonry or concrete walls shall be provided with a ½-inch (13 mm) air space on top, sides and end, unless approved naturally durable or *preservative-treated* wood is used.

2311.4.5 Clearance: Clearance between wood siding and earth on the exterior of a building shall not be less than six inches (152 mm) except where siding, sheathing and wall framing are of approved *preservative-treated* wood.

2. Posts or columns in enclosed crawl spaces or unexcavated areas located within the periphery of the building, supported by a concrete pier or metal pedestal at a height greater than eight inches (203 mm) from exposed ground, and are separated therefrom by an impervious moisture barrier.

2311.5 Wood in contact with the ground: All wood in contact with the ground (exposed earth) which supports permanent structures that are intended for human occupancy, shall be of approved naturally durable or *preservative-treated* wood using water-borne *preservatives* and shall be treated in accordance with AWPAC2 or C9 listed in **Appendix A** for ground contact, where used in the locations specified in 780 CMR 2311.5.1 and 2311.5.2.

Exception: Untreated wood is permitted where such wood is entirely below the ground water level or where continuously submerged in fresh water.

2311.5.1 Posts or columns: Sawn posts and columns supporting permanent structures that are intended for human occupancy and which are embedded in concrete in direct contact with the earth or embedded in concrete exposed to the

2311.4.6 Posts or columns: Posts or columns supporting permanent structures and supported by a concrete or masonry slab or footing which is in direct contact with the earth shall be of approved naturally durable or *preservative-treated* wood

Exceptions:

1. Posts or columns which are either exposed to the weather or located in *basements* or cellars, supported by concrete piers or metal pedestals projecting at least one inch (25 mm) above the slab or deck and six inches (152 mm) above exposed earth, and are separated therefrom by an impervious moisture barrier.

weather, or in direct contact with the earth, shall be of approved *preservative-treated* wood.

2311.5.2 Wood structural members: Wood structural members that support moisture-permeable floors or roofs which are exposed to the weather - such as concrete or masonry slabs - shall be of approved naturally durable or *preservative-treated* wood unless separated from such floors or roofs by an impervious moisture barrier.

2311.6 Geographical areas: In geographical areas where experience has demonstrated a specific need, approved naturally durable or *preservative-treated* wood shall be utilized for those portions of wood members which form the structural supports of buildings, balconies, porches or similar permanent building appurtenances where such members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering to prevent moisture or water accumulation on the surface or at joints between members. Depending on local experience, such members include, but are not limited to, the following:

1. Horizontal members such as girders, joists and decking;
2. Vertical members such as posts, poles and columns; or

THE MASSACHUSETTS STATE BUILDING CODE

3. Both horizontal and vertical members.

2311.7 Wood used in retaining walls: Wood installed in retaining or crib walls shall be of approved *preservative-treated* wood treated in accordance with AWPA C2 or C9 listed in **Appendix A** for ground contact, except as indicated in 780 CMR 2311.7.1 through 2311.7.3.

2311.7.1 Untreated wood: Where the wall is not more than two feet (610 mm) in height and is separated from the *lot line* or a permanent building by a minimum distance equal to the height of the wall, the wall is permitted to be of untreated wood.

2311.7.2 Naturally durable wood on the lot line: Where a retaining wall or a crib wall is not more than two feet (610 mm) in height and is located on the *lot line*, approved naturally durable wood is permitted.

2311.7.3 Naturally durable wood separated: Where a retaining wall or a crib wall is not more than four feet (1219 mm) in height and is separated from the *lot line* or a permanent building by a minimum distance equal to the height of the wall, approved naturally durable wood is permitted.

780 CMR 2312.0 JOIST HANGERS

2312.1 Test standard: The vertical loadbearing capacity, torsional moment capacity, and deflection characteristics of joist hangers shall be determined in

2312.3 Torsional moment capacity: The torsional moment capacity for the joist hanger shall be determined by testing at least three joist hanger assemblies as specified in ASTM D1761 listed in **Appendix A**. The allowable torsional moment for normal *duration of loading* of the joist hanger shall be the average torsional moment at which the lateral movement of the top or bottom of the joist with

accordance with ASTM D1761 listed in **Appendix A**, using lumber having a specific gravity of 0.49 or greater but not greater than 0.55 as determined in accordance with AFPA NDS listed in **Appendix A** for the joist and headers.

2312.2 Vertical load capacity: The vertical *load* capacity for the joist hanger shall be determined by testing three joist hanger assemblies as specified in ASTM D1761 listed in **Appendix A**. If the ultimate vertical *load* for any one of the tests varies more than 20% from the average ultimate vertical *load*, at least three additional tests shall be conducted. The allowable vertical *load* for a normal *duration of loading* of the joist hanger shall be the lowest value determined from the following:

1. The lowest ultimate vertical *load* from any test divided by 2.5 (where three tests are conducted and each ultimate vertical *load* does not vary more than 20% from the average ultimate vertical *load*).
2. The average ultimate vertical *load* for all tests divided by six (where six tests are conducted).
3. The vertical *load* at which the vertical movement of the joist with respect to the header is 0.125 inch (3 mm) in any test.
4. The allowable design *load* for nails or other fasteners utilized to secure the joist hanger to the wood members.
5. The allowable design *load* for the wood members forming the connection.

respect to the original position of the joist is 0.125 inch.

2312.4 Design value modifications: Allowable design values for joist hangers which are determined by failure of the metal-to-wood connection shall be permitted to be modified by the appropriate *duration of loading* factors as specified in AFPA NDS listed in **Appendix A**. Allowable design values determined by

failure of the metal joist hanger shall not be modified by *duration of loading* factors.

780 CMR 2313.0 PREFABRICATED COMPONENTS

2313.1 Structural glued-laminated members: Buildings and structures designed and erected of glued-laminated structural members or of composite members of dimension lumber and wood structural panels shall comply with 780 CMR 2313.0.

2313.1.1 Exposed structural glued-laminated timber: Those portions of glued-laminated timbers which form the structural supports of a building or other structure and are exposed to weather and not properly protected by a roof, eave overhang or similar covering, shall be treated in accordance with AITC 109 listed in *Appendix A* or shall be manufactured from approved naturally durable woods.

2313.1.2 Glued-laminated members: Design and fabrication of built-up beam and column sections, which consist of one or more webs with glued-lumber flanges and stiffeners, shall be based upon an approved method which takes into consideration the conditions of use. Glued-laminated elements shall be subject to a quality control program administered by an *approved agency* and shall bear a *label* in accordance with 780 CMR 1704.3. Such *label* shall contain the information required by 780 CMR 1704.3.3.

2313.1.3 Gluing surfaces: In glued-lumber constructions, the surfaces to be glued shall be worked to a smooth, flat surface without sanding and shall be free from wax, grease or oil to insure a complete glue bond over the entire contact. Factory-sanded wood structural panels shall be permitted.

2313.2 Sandwich panels: Design and fabrication of sandwich panels or other integrated assemblies which

are fabricated of dimension lumber with wood stress coverings glued thereto, or which consist of structural units of metal-covered or molded wood structural panels or other approved plastics formed and molded into prefabricated loadbearing members, shall be based upon an approved method which takes into consideration the conditions of installation or meets the test requirements of 780 CMR 1704.0, 1709.0 and 1710.0. Sandwich panels shall be subject to a quality control program administered by an *approved agency* and shall bear a *label* in accordance with 780 CMR 1704.3. Such *label* shall contain the information required by 780 CMR 1704.3.3

2313.2.1 Splices: Splices and connections between panels shall be weather tight and shall be of sufficient strength to resist two and one-half times the design *live load* to which such splices will be subjected in normal installation. The fastening of coverings to structural studs, ribs or joists shall provide a rigidity equivalent to approved gluing. Nailing shall not be acceptable for that purpose.

2313.3 Prefabricated trusses: Prefabricated trusses shall be designed to resist all superimposed design loads.

2313.3.1 Roof trusses: Metal-plate-connected roof trusses shall be designed in accordance with TPI *Design Specifications for Metal Plate Connected Wood Trusses* and AFPA NDS listed in *Appendix A*, and shall be braced to prevent rotation and provide lateral stability.

2313.3.2 Floor trusses: Metal-plate-connected floor trusses shall be designed in accordance with TPI *Design Specifications for Metal Plate Connected Parallel Chord Wood Trusses* and AFPA NDS listed in *Appendix A*.

2313.4 Special inspection: The fabrication process for prefabricated wood components shall be subject to *special inspection* as required by 780 CMR 1705.4.

780 CMR: STATE BOARD OF BUILDING REGULATIONS AND STANDARDS
THE MASSACHUSETTS STATE BUILDING CODE

2313.5 Prefabricated wood I-joists: Structural capacities and design provisions for prefabricated wood I joists shall be established and monitored in accordance with ASTM D5055 listed in *Appendix A*.

NON-TEXT PAGE